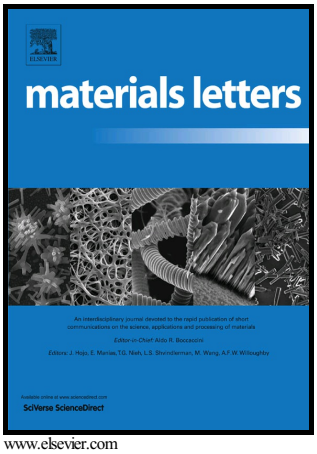

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Yan Yan, Jie Guo, Jie Li, Rongxing Li

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Magnetically Exchange Coupled MnBi/FeCo Thin Film Composites with Enhanced Maximum Energy Products

Yan Yan[a*], Jie Guo[b], Jie Li[c], Rongxing Li[d*]

[a]Hebei Key Laboratory of Data Science and Applications, North China University of Science and Technology, Tangshan, Hebei, China

[b]Department of Physical Education, Tang Shan Normal University, Tangshan, Hebei, China

[c]The ministry of education key laboratory with modern metallurgical technology, North china university of science and technology, Tangshan, Hebei, China

[d]Department of Materials Science and Engineering, Xiamen University, Fujian, China

yanjxky@126.com

rongxingliedu@gmail.com

*Corresponding author.

Abstract:

MnBi/FeCo thin film composites are synthesized by magnetron sputtering, the physical and crystal structures are confirmed by SEM and XRD. The magnetic properties are characterized by VSM. When the FeCo layer thickness is 2 and 4 nm, magnetic exchange coupling between MnBi and FeCo is demonstrated by enhanced maximum energy product in MnBi/FeCo thin films from the single hard phase of MnBi. When the FeCo thickness is further increased to 6 nm, the exchange coupling between MnBi and FeCo is destroyed in MnBi/FeCo thin films. This research explored a possible way to increase the maximum energy product of MnBi thin films.

Keywords: Composite materials; Crystal growth; Sputtering; Magnetic materials.

1. Introduction

The research of rare-earth free permanent magnets has been extensively conducted in past couple of years due to unstable prices of rare-earth elements in the market, and their uneven geological distributions (mainly in China) [1-5]. In the past few years, the United States of America (USA), European Union (EU) and Japan have launched several huge research projects on the research and development of strong permanent magnets without using rare earth elements. For example, Xu et al at the University of Alabama (USA) proposed the concept of magnetic self-assembly, and synthesized magnetically exchange coupled MnBi/FeCo [6] and $SrFe_{12}O_{19}$/FeCo [7-9] composites with enhanced energy products; Anagnostopoulou et al at Université de Toulouse (France) synthesized Cobalt nanorods with wet chemistry, and achieved